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The Torpedo-Virator

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THE TORPEDO-VIRATOR.

By Rear-Admiral BÖRRESEN,
Chief of the Staff of the Norwegian Navy.

ADJUSTABLE gyroscopes, that is gyroscopes that can be so regulated as to make the torpedo run in any angle from the line of sight, are hardly used in any Navy at the present moment, because the gyroscope is considered too complicated and too fine an instrument for such regulations in the last minute before firing the torpedo.

But whether the gyroscope is regulated, or constructed to work, in the axis of the torpedo or to work at a certain angle, of say 30°, from this axis, when the gyroscope is *permanently* fixed for this angle—this circumstance evidently has nothing to do with the regular working or the complication of the instrument. The gyroscope, in fact, will do its duty without knowing that it is deflecting a torpedo 30° from the line of sight.

Or rather, gyroscopes *permanently* fixed to deflect a torpedo a certain angle from the line of sight cannot be called adjustable gyroscopes at all. They are just as good and just as safe as those that are constructed for a straight run.

The reason why these *permanently* deflected gyroscopes are not in use is most likely the circumstance that they require an exact knowledge of the distance to the hostile ship at the moment of firing.

Fig. I.

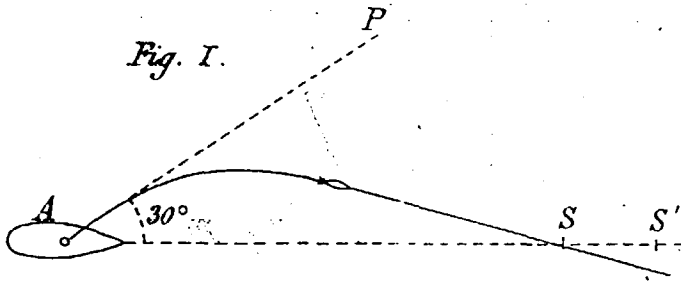


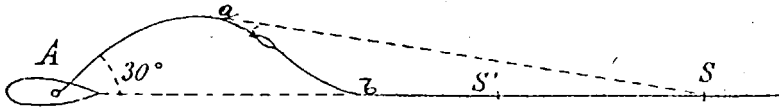
Fig. 1 represents a torpedo-boat that fires her torpedo with a gyroscope deflected 30° to the right. The line of sight is *A S*, the line of launching is *A P*. With a gyroscope deflected 30°, the torpedo will hit the vessel *S* only if the vessel just happens to be in the point where the trajectory of the torpedo and the line of sight cross each other. But if the hostile ship is in the point *S'*, the torpedo will miss her.

As a consequence one cannot use deflected torpedoes unless one knows the distance to the ship fired at, and corrects for it—which is out of the question.

To do away with this difficulty, and at the same time have all the advantages that a deflected gyroscope gives, I have devised and tried

in the Norwegian Navy, with great success and accuracy, a small and very simple instrument, which makes the torpedo run into the sighting line again as soon as it has been deflected (see Fig. 2).

Fig. II.



That is to say it does not follow the dotted line *a S*, Fig. 2, but continues its curve until a point *b* near the sighting line, and then runs into this line; in short, the torpedo is given a "flat" trajectory.

This arrangement will give one the advantage of being able to fire right ahead (or right astern) from a ship, without stem or stern tube, and hit with the same accuracy as if direct firing had been used.

The instrument has been tried continuously at the naval shooting ground at Horten, and every time the torpedo has run into the sighting line as if it had been shot out by direct firing, although its original angle of launching has been 45°.

There need, therefore, no longer be any guessing of the distance; the torpedo will hit the hostile ship whether she is in *S* or *S'*.

Let me repeat again that this process of indirect firing need not involve any regulation of the gyroscope in the last moment.

The gyroscope in this torpedo is *always, from the very beginning*, made to work in an angle of 30°, or 45°, or 90°, etc., with the axis of the torpedo. And the little instrument, which I propose to describe, does not interfere with the ordinary working of the gyroscope, or rather it does not touch it. It is placed on one of the "fins" of the torpedo.

If the hostile ship is in the point *S* (Fig. 3), one uses the same torpedo and lets it make the same curve.

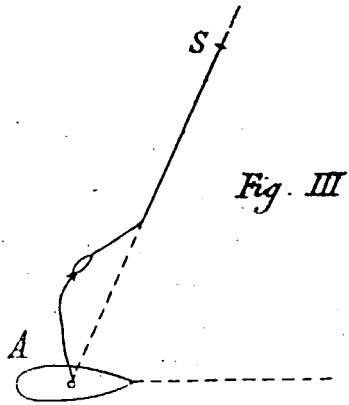


Fig. III

If a torpedo-boat has two torpedo-guns, it is advisable in the foremost gun to have a torpedo with a gyroscope deflected 30°, for instance, to the right, in the after gun a gyroscope deflected 30° to the left; as this arrangement will give an all-round fire, and an all-round torpedo fire is a very important thing for a torpedo-boat, which in a dark night

must be prepared to meet an enemy in any direction, and naturally prefers to fire as soon as possible without taking the time to turn the vessel. This will be seen from Figs. 4, 5, and 6, Fig. 4 representing a torpedo-boat with two torpedo-guns of the old system, that cannot

Fig IV.

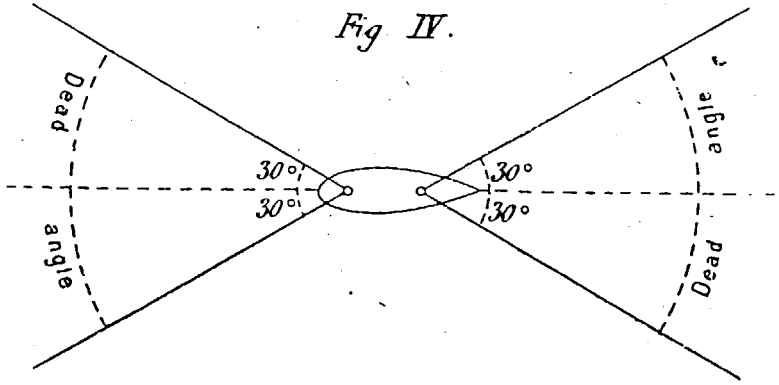
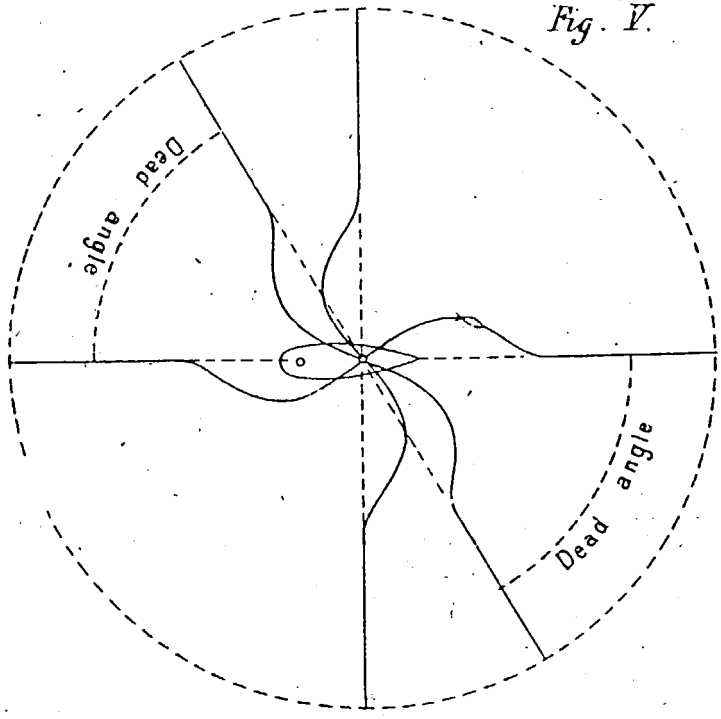


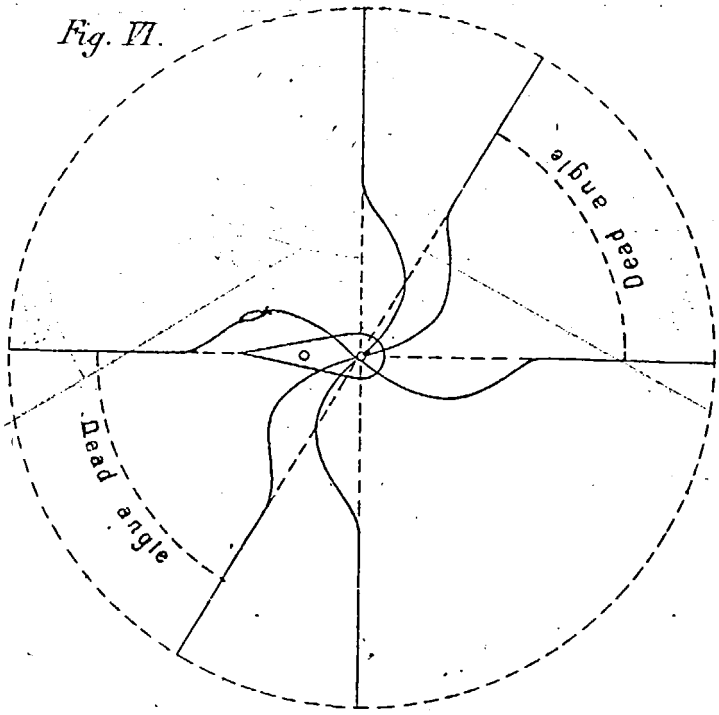
Fig. V.



fire right ahead or right astern; Figs. 5 and 6, the same torpedo-boat with all-round fire by the above-named device, her fore torpedo deflected 30° to the right and her after torpedo deflected 30° to the left.

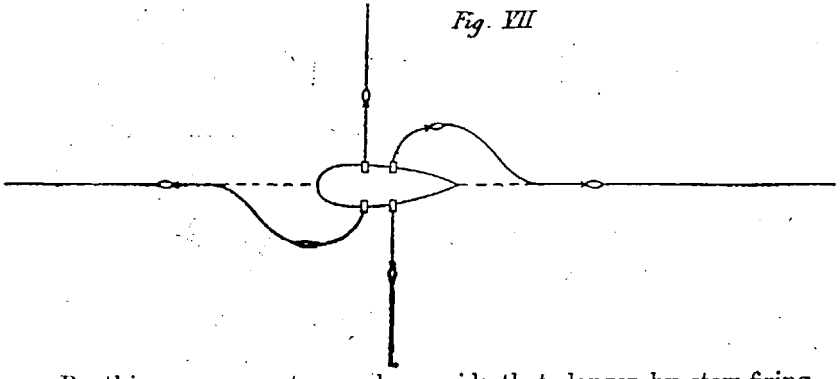
From a constructional as well as from an administrative point of view, it is a great disadvantage to have in a large ship several torpedo-batteries in stem, stern, and amidships.

Fig. VI.



By this device all the torpedo-tubes can be concentrated in one great torpedo discharge-room amidships; one tube to be used for stern fire, one for stem fire, and two for beam firing (see Fig. 7), and possibly also tubes for firing 45° on the bow or quarter.

Fig. VII



By this arrangement one also avoids that danger by stem-firing, that the ship can run into her own torpedo if the torpedo is not properly launched.

From what is above mentioned it will have been understood that the gyroscopes in these torpedoes are *permanently* fixed to work in a

certain angle from the axis of the torpedo, and as a consequence, in the moment of firing, automatically lay the vertical rudder hard port (or starboard).

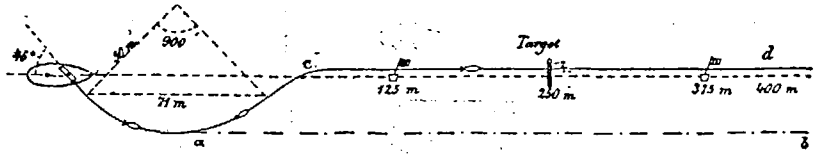
The function of the torpedo-virator is to keep the rudder in this position (hard port or hard starboard), until the torpedo is in a point (*b*, Fig. 2) near the sighting line.

When the torpedo has reached point *a*, that is, has turned 30°, the gyroscope will (without this instrument) steady the torpedo, and a faulty angle will arise, which requires for its re-adjustment a knowledge of the distance.

The instrument, however, which I propose to introduce, keeps the rudder hard port (or starboard) until the torpedo reaches point *b*, near the sighting line, and then lets the rudder free to be worked by the gyroscope.

After this point *b*, therefore, the torpedo will run a straight course —keep in the sighting line,—and that it really does so, my experiments abundantly show.

Fig VIII.

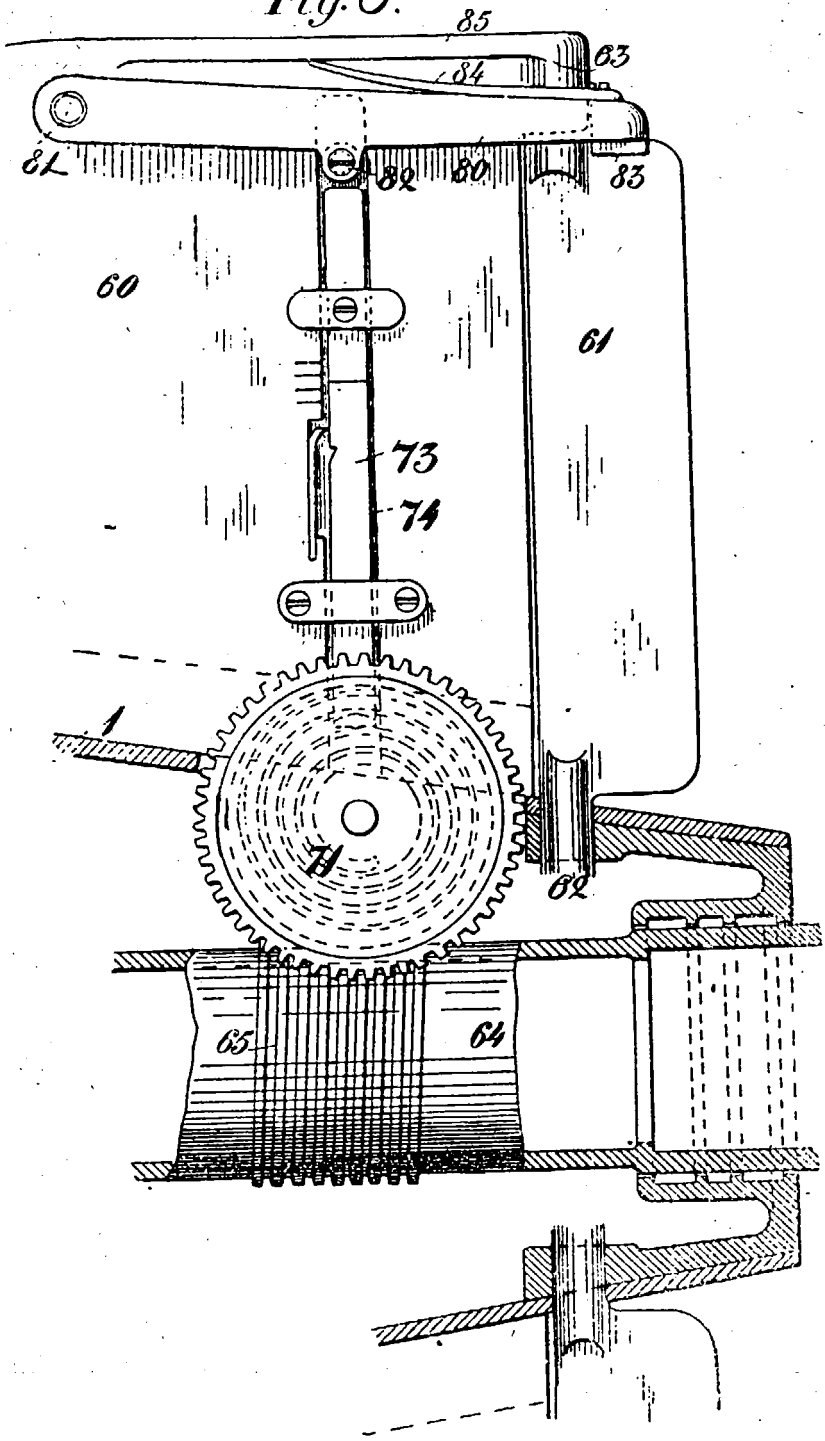


The above-mentioned apparatus is illustrated in Figs. 9, 10, and 11, in which number 1 indicates the shell of the torpedo. 60 is one of the fins, 61 one of the vertical rudders, having one of its bearings in the shell at 62, and the other at 63 near the edge of the fin. 64 is the shaft of one of the propellers. This shaft is provided at 65 with screw-threads. Right above this point, on a fixed axle, 66, a screw-wheel, 67, is loosely mounted, engaging with its teeth the threads of the screw 65. Close to this screw-wheel another wheel, 68, is also loosely mounted on the axle, 66. By means of a screw, or pin, 69 in the wheel 67, entering a hole, 70, in the wheel, 68, the two wheels may be coupled together in an easy way. The wheel 68 is provided with a spiral groove, 71, on its other side, and entering this spiral groove, with a pin or projection, 72, a radially movable pusher-rod, 73, is mounted in a radial slot, 74, in the fin 60. Near the edge of the fin an arm, 80, is mounted. It is shown as composed out of two branches, one on each side of the fin, united at the fulcrum by the pin 81, at the middle by a stay, 82, and at the end, where on the underside it carries a triangular lug, 83, which serves as a stop for the rudder. The arm is held down by a two-armed spring, 84, acting against ribs, 85, on the fin.

In the position shown the said lug holds the rudder starboard.

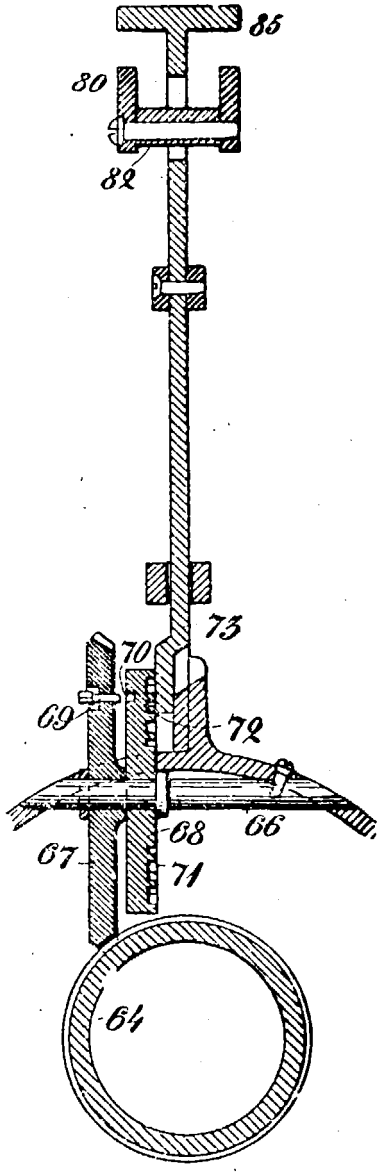
When the screw, 65, rotates, it drives the wheel 67, and this being coupled with the wheel 68, causes this to rotate, and the spiral groove on the latter will force the pusher-rod, 73, upward, so that its end will hit the arm, 80, and lift it, whereby the rudder will be released so that it can move freely. By loosening the screw 69, the wheel 68 may be turned, whereby the starting position of the pusher-rod, 73, is adjusted and thereby the apparatus timed. An index may, as shown, be provided on the rod whereby the exact adjustment for different angles of ejection may be provided for.

Fig. 9.



Experiments with the before-described apparatus have been carried out with different types of torpedoes at the Norwegian naval station at Horten, and they have all shown that it works with the greatest possible accuracy.

Fig. 10.



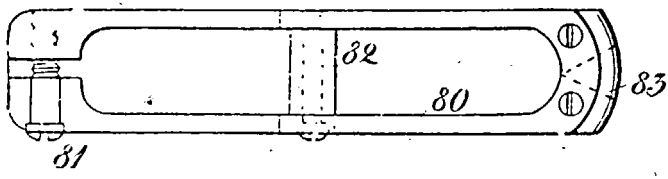
The adjustment of the wheel 71 (or the push-rod, 73) will, of course, depend on the angle between the torpedo-tube in the moment of firing

and the line of sight —the gyroscopic angle—and the turning diameter of the torpedo, but for the same torpedo and the same angle the adjustment will always be the same. The wheel 71 has to be regulated for a number of teeth corresponding to the number of revolutions of the engine until the torpedo has reached the sighting line.

The first experiments were made with a 3·7-metre by 45-centimetre torpedo, with Woolwich tail, and turning diameter of circa 100 metres.

The torpedo was launched from a torpedo-gun 3 metres above water, and the gyroscope regulated for an angle of 45°. The wheel, 71, was set for 79 teeth (that is to say, the vertical rudder would be free to be acted upon by the gyroscope when the engine of the torpedo had made 79 revolutions).

Fig. 11.



Without the apparatus the torpedo would have had a trajectory, *a*—*b*, Fig. 8, 24 metres, to the right of the sighting line and the centre of the target.

It now continued its curve, however, till the point *c*, where it lay the rudder hard port, and swung into the line *c*, *d*, parallel to the sighting line, and 2 metres to the left of the centre of the target.

The wheel (71) was then set for 78 teeth, and the torpedo ran through the centre of the target.

Later, many more experiments have been made with the same excellent results, also with the long torpedoes with Fiume tails and wider turning diameters, which, however, it is always preferable to reduce as much as convenient.

If in order to reduce the turning diameter it should prove desirable to use a larger vertical rudder than is desirable during the straight run, the rudder can be made of two parts, the after part

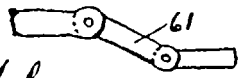
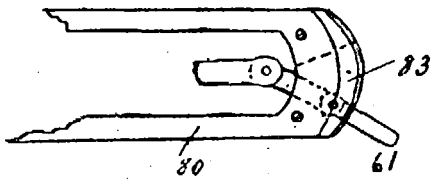


Fig. 11, b



hinged to the foremost part so that it is loose and does not affect the steering when the triangular lug, 83, has been pushed up.